Chapter 12: Buildings

Presenter:

Chris D. Poland PE, SE, NAE
Consulting Engineer
NIST Disaster Resilience Fellow

Chairman, CEO Degenkolb Engineers (Retired)

Buildings Matrix

Table 9-11: Riverbend, USA building performance goals for design earthquake

Disturbance [1]	
Hazard Type	Earthquake
Hazard Level	Design
Affected Area	Community
Disruption Level	Moderate

Restoration Levels [2,3]	
30%	Function Restored
60%	Function Restored
90%	Function Restored
X	Anticipated Performance

Building Clusters	Support Needed[4]	Design Hazard Performance								
		Phase 1 Short-Term			Phase 2 Intermediate			Phase 3 Long-Term		
		Days			Weeks			Months		
		0	1	1-3	1-4	4-8	8-12	4	4-24	24+
		Building Performance Category								
		A			B			C		D
Critical Facilities										
Emergency Operation Centers	R, S, MS	90%							X	
First Responder Facilities	R, S, MS	90%							X	
Memorial Hospital	R, S, MS	90%							X	
Non-ambulatory Occupants (prisons, nursing homes, etc.)	R, S, MS	90%							X	
National Aircraft Parts Factory (NAP)	R, S, C	90%							X	
Emergency Housing										
Temporary Emergency Shelters	R, S	30%	90%							X
Single and Multi-family Housing (Shelter in place)	R, S	60%			90%					X
Housing/Neighborhood										
Critical Retail	R, S, C		30%	60%	90%					X
Religious and Spiritual Centers	R, S			30%	60%	90%				X
Single and Multi-family Housing (Full Function)	R, S			30%		60%		90%		X
Schools	R, S			30%	60%	90%				X
Hotels & Motels	R, S, C			30%		60%	90%			X
Community Recovery										
Businesses – Manufacturing (except NAP)	R, S, C				30%	60%	90%			X
Businesses - Commodity Services	R, S, C				30%	60%		90%		X
Businesses - Service Professions	R, S, C				30%		60%		90%	X
Conference & Event Venues	R, S, C				30%		60%		90%	X

Footnotes:

1 Specify hazard type being considered
Specify hazard level – Routine, Design, Extreme
Specify the anticipated size of the area affected – Local, Community, Regional
Specify anticipated severity of disruption – Minor, Moderate, Severe

2 30% | 60% | 90% Desired restoration times for percentage of elements within the cluster

3 X Anticipated performance for 90% restoration of cluster for existing buildings and infrastructure systems
Cluster recovery times will be shown on the Summary Matrix

4 Indicate levels of support anticipated by plan
R = Regional; S= State; MS=Multi-State; C = Civil (Corporate/Local)

Buildings Chapter

Figure 1-1: Six-step planning process for community resilience

Provides Guidance for:

Step 2 – Understand the situation

- Identify and Characterize built environment

Step 3 – Determine Goals and Objectives

- Establish Performance Goals
- Determine Anticipated Performance

Step 4 – Plan Development

- Develop Implementation Strategy



Current Building Design Criteria
Section 12.2

General Basis – Prescriptive Model Codes and Standards

- 2015 International Buildings Code
- 2015 National Fire Protection Association
- American Society of Civil Engineers Standard 7

Basis for design criteria used to determine desired performance–

- Use
- Occupancy
- Public Health, Safety and Welfare
- Risk Categories to address structural failure

Defined Performance Categories

Table 12-2

A – Safe & Operational

B – Safe & Usable During Repair

C – Safe & Not Usable

D – Unsafe

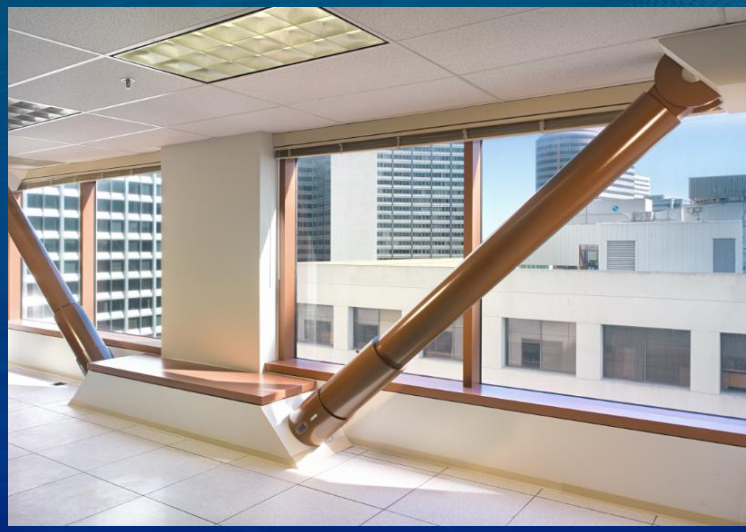
Section 12.2 and 12.3 link occupancies and code provisions with performance categories

Photos courtesy of Chris Poland

Achieving Specific Performance Goals

Section 12.5

- Hazard levels and design loads defined based ASCE 7-10 and local determination.
- Current code design provisions need to be modified to achieve performance levels for new buildings.
- Existing buildings built to outdated codes likely need to be retrofit or replaced to meet community goals.



Photos courtesy of Degenkolb Engineers

Determining Anticipated Performance

Section 12.6.1

- Codes, standards, and building practice have been constantly evolving
- Structural standards are typically not retroactive
- Available evaluation tools are identified
  - ASCE 41-13 for Seismic
  - HAZUS for community level assessment
  - FEMA Design and Evaluation Guides
  - Other available tools from ICC and ATC

Photos courtesy of Degenkolb Engineers

Implementation Guidance

- Future Construction – Section 12.6.2
  - Adopt local requirements as needed to achieve community determined performance goals.
  - Only build outside of flood zones
  - Implement design provisions to limit damage
  - Design for drainage during design level rain events
- Existing Construction – Section 12.6.3
  - Encourage voluntary retrofit and implement mandatory requirements when needed
  - Includes hazard specific recommendations